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The American Association for the Advancement of Science:
Science, War and Reconstruction: DR. JULIAN SORELL HUXLEY 151

The Gravity Anomaly: DR. WILLIAM BOWIE 158

Obituary:
Charles Zeleny: PROFESSOR FERNANDUS PAYNE. *Almon Ernest Parkins:* DR. S. C. GARRISON and DR. H. A. WEBB. *Recent Deaths and Memorials* 160

Scientific Events:
The New York Academy of Medicine; Symposium of the Society for Development and Growth; Research Conferences on Chemistry at Gibson Island; Bermuda Biological Station for Research; The Phipps Auditorium of the Colorado Museum of Natural History; Gifts for Scientific Research to Cornell University 161

Scientific Notes and News 164

Discussion:
The Smaller Animals of the Great Plains: PROFESSOR V. E. SHELFORD. *Anaplasmosis among Deer in the Natural State:* DR. WILLIAM HUTCHINS BOYNTON and GLADYS M. WOODS. *Increasing the Usefulness of Maps:* PROFESSOR R. L. EDWARDS 167

Special Articles:
Manganese Deficiency for Citrus in California: DR. E. R. PARKER, DR. H. D. CHAPMAN and R. W. SOUTHWICK. *The Production and Utilization of Alcohol by Plant Tissues:* DR. C. A. LUDWIG and OTHERS. *The Effects of a Beef Liver Fraction upon Fat Synthesis in Rats:* PROFESSOR E. W. MCHENRY and GERTRUDE GAVIN. *The Pigment of the Vertebrate Lens:* DR. GORDON L. WALLS 169

Scientific Apparatus and Laboratory Methods:
An Apparatus for the Study of Experimental Airborne Disease: PROFESSOR W. F. WELLS. *Halowax-paraffine for Infiltrating Histologic Tissues:* PROFESSOR ED. D. CRABB 172

Science News 8

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SCIENCE, WAR AND RECONSTRUCTION[1]

By Dr. JULIAN SORELL HUXLEY

LONDON, ENGLAND

WHAT can a natural scientist say about war and reconstruction which can not be better said by a sociologist, a political scientist, a historian or a practical politician? He can at least attempt to see this war and the problem of war in general in the long-range perspective of science, even though, if he is not to indulge in the merest puerilities, he must not be afraid of leaving his last and becoming a "political animal" as well as a mere scientist.

War, in its proper sense of organized intra-specific group fighting, is a very peculiar phenomenon. So far as is known, it is confined to men and to a few species of ants. This does not mean that war is instinctive in man as it must be in ants. The evidence from some ancient civilizations, such as Mohenjo-Daro, indicates that they were wholly pacific. In any case, the basic quality of man's nature is its plasticity, its absence of unalterable instincts. To say that it is hopeless to try to eradicate war because that would mean altering human nature is unscientific. It rests on a confusion between phenotypic human nature, as actually expressed, and human nature as something genetically given. The former can readily be modified, the latter can not. War is a phenomenon on a par with duelling and religious persecution. These latter have dropped out of civilized societies without any alteration in the genetic basis of human nature: and the same could be accomplished for war.

War is of course not the same as conflict. Conflict is a permanently inevitable feature of human life—internal conflict, conflict between individuals, conflict between groups. The overcoming of conflict in the right way is indeed an indispensable process in the development of human personality. But inter-group

[1] The first address in America under the arrangement between the American Association for the Advancement of Science and the British Association for the Advancement of Science for exchange lectures on alternate years. Columbus, Ohio, December 29, 1939.

conflict need no more lead to war than inter-individual conflict to murder or intra-individual conflict to suicide or a nervous breakdown.

We may admit that phenotypic human nature is essentially plastic: but we must not forget that wherever repression has been operative—and repression of some sort is probably well-nigh universal among human beings—there will be great resistance to change of outlook and even to self-knowledge. It is undoubted that repressed sadistic impulses, inferiority complexes, and the like, provide ready fuel for inflammation by war, and that not merely political and economic machinery but also the structure of developing human minds should be modified if war is to be made really unlikely. At the moment, the resistance to self-knowledge in this field extends to the level of educators and scientists: it is an important task of the near future to break down this resistance, face the facts (however unpleasant) fairly and squarely, and devise a system of education and training which will get rid of this dangerous reservoir of undesirable repressions.

War evolves and changes like other social activities. Tribal wars are very different from imperialist wars, such as those of Rome, Spain and Britain, from religious wars, from dynastic wars fought with mercenary armies. To-day the type of war is nationalist, between nation-states; and in the last century this type of war has become increasingly totalitarian and increasingly scientific, until it is now defeating its own ends—not only in being out of scale with its possible functions, as mentioned below, but by causing stalemate when two reasonably equal powers are matched, partly by the increase of the power of the defensive, partly by holding back aerial attack for fear of reprisals.

War, except in a polygamous tribal society, is dysgenic. Even totalitarian wars with reservation of specialist brain-power for non-combatant uses are still somewhat dysgenic, and so long as the voluntary principle was in force, and the national need great, as in Britain in 1914, the dysgenic effects were appallingly large.

To-day, however, the social ill-effects of war are much more serious than the biological. Quite apart from the effects of militarization and regimentation of the people in every type of activity, war is now so expensive that it bleeds countries white, and interferes very seriously with social progress. A temporary boom and reduction of unemployment due to arming for war does not alter the basic fact that the more we spend on armaments, the poorer we become. Britain alone is spending some £6 million per day on this war. It is becoming poorer instead of richer, as it would be if the same amount were spent on health, education, research, new roads and other needed public works, the reequipment of industrial plants, and so forth.

But do not let us forget that war has still another social function—it can be, and often is, the occasion for valuable change. To take but three examples, the last war brought about the peaceful settlement of the long-standing and acrimonious dispute over women's suffrage in Britain; forced the medical profession in general to recognize the power of repressed unconscious impulses, and so gave a most powerful impulse to the growth of modern psychology; and led to the formation of the League of Nations, which, for all its defects, was the first serious attempt to realize a supernational organization, and from whose defects we have been able to learn valuable lessons for the future.

I suppose that every one of us realizes, though with very different degrees of awareness and to the accompaniment of feelings that range from ardent hope to sullen resistance, that this war too is bound to be an occasion of change, notably of radical changes in the structure of separate societies and the organization of the world. A biologist may be pardoned for maintaining that the biological analogy is helpful not only in creating a general background against which to envisage the coming change, but sometimes in suggesting detailed points in the new order.

In the first place, biology reminds us that change is the normal (though not the universal) rule of life, that certain aspects of biological change can legitimately be called progress, and that man is (biologically speaking) a very recent type, whose social organization is still primitive in the extreme when looked at in the light of evolution. The lesson of biology for the resistant conservative is therefore that his general resistance to change is not only useless but immoral.

But biology has also a warning for the over-enthusiastic progressive. Biological change has normally (though perhaps not universally) been gradual. The rate may vary considerably as between different lines of descent, and at different periods of the world's history, but the change is normally effected through step-by-step alterations of existing organization. In general, it is as frequent for old organs to be converted to new uses as for wholly new organs to be evolved. The zeal of the revolutionary for getting rid of the old system root and branch is thus likely to be wastefully destructive and in the long run to delay progress.

From the standpoint of human biology, what are the chief features of the present time which have altered man's social environment so much that corresponding alterations of social organization are needed to meet them?

The first is the increase in the efficiency and speed of transport and communications, accompanied by the virtual abolishing of frontier-space for expansion. This, as Mr. Wells has so often reminded us, is forcing the remotest regions of the world into often unwilling interaction. It provides a potential basis on which

world unity could be built, and at the same time makes the lack of that unity more and more disadvantageous.

The second is the increase in the potential of power available to states. This is most dramatically seen in respect of war. Armaments have become many times more efficient during the last twenty years: in the last war there were no fortifications remotely approaching the Maginot line in strength, and neither tanks nor machine-guns nor bombers nor fighting planes could compare either in quantity or in all the qualities of their species with those available to-day. The result is that war has become out of scale with its function. During many centuries it operated, wastefully enough, yet with a certain efficiency, in adjusting the variations in the balance of power caused by geographical discovery, economic change and population-pressure. But to-day both its destructiveness and its expensiveness have got out of hand, and have become wholly incommensurate with any positive results which it may help to secure.

This, however, is not the only way in which state power has shot up. The dictator régimes have taken into their own hands the organization of economic power and also of the power of opinion. They are in literal truth totalitarian.

The biological analogy shows that for competing nation-states, such as the great democracies, merely to respond to this challenge by corresponding permanent changes in their own organization (however necessary as a temporary measure) would be to court disaster. Size and armament alone lead up a cul-de-sac. The giant reptiles of the Mesozoic included the largest land carnivores the world has ever seen, like the Tyrannosaurs, and the most heavily armored animals, like the Stegosaurs and the Ceratopsians. They answered bulk with bulk, aggressive with defensive warfare. But they were all doomed to extinction as soon as the changing environment gave the insignificant but brainier little mammals their chance. The contraction of the world due to better communications provides the corresponding change of environment to-day: brain-power spent on devising and running some new system is inevitably destined to supplant the present armored monsters of the nation-state era. The only question is whether it shall be now or after more waste and destruction.

We have numerous examples in evolution of biological short cuts which fade out after a temporary success; a great many of these secure temporary success at the price of continuing adaptability and genetic plasticity—for instance, plants with allotetraploidy but without sexual reproduction, or those which have adopted a ring formation of reciprocally translocated chromosomes. It would appear that the totalitarian state of the Nazi type suffers in this respect also—in being less plastic than the democratic state, although initially more efficient.

A third fact of the utmost importance in the modern world is the search for a new mystic, a new super-personal driving force. Traditional religion of the supernatural type has lost both ground and grip: the curious materialist-idealist compound which expressed itself in the nineteenth century's belief in the inevitability of progress, in the power of knowledge to mould human nature and produce almost millennial prosperity and peace, has wilted in disillusion. In their place, three great nations have already erected new pseudo-religions, all of them involving the glorification of the state. The most radical is that of Nazi Germany, which uses the race-concept as its mystical basis, while for Italy the mystic is the nation, for Russia the millennial picture of the truly Communist society, when government will wither away.

In all these cases, however, the mystical driving concept is linked with the national organization of power: and this inevitably has brought a recrudescence of intolerance, persecution and cruelty: the fully totalitarian state, as organized to-day, appears to be unavoidably immoral, cruel and intolerant of free ideas. This recrudescence has contributed largely to the final shattering of the belief in progress in other nations. History teaches us, however, that intolerant persecution always arises when an unintelligent mystic doctrine is held with such intensity that the end is deemed to justify the means; and that the persecution will be violent and brutal when the mystic doctrine is bound up with the system of power.

Two by-products of this situation are to be noted. First, the unprecedented refugee problem which it has created—unprecedented partly because of the violence and extent of the persecution, partly because of the nationalist unwillingness of other states to absorb new alien elements. And secondly the distortion of truth which it has brought about, with resultant lowering of the quality of scientific research in the countries concerned. A biological analogy here would seem to be the incredibly small size of the brains of the giant mesozoic reptiles.

The fourth great future of the present is the trend away from *laisser-faire* and individualism towards planned organization and collective action. During the period of rapid industrial expansion in the nineteenth century, *laisser-faire* individualism worked well enough, in spite of all its attendant horrors of slums, exploited labor and imperialist expansion. Indeed, it is probable that no other system could have so rapidly mastered the forces and resources of the world. But to-day, like war, it is defeating its own ends and proving unsuitable for its functions. It is proving unsuitable for four main reasons—first, because unplanned individualisms, as the world contracts, tend to cancel

each other out; secondly, because its basic time-span is too short for many types of projects—the individual demands a return on his money within his own lifetime or at least for his children. Thirdly, because the investing agent is too localized; the individual demands a direct return to himself or to his family whereas many projects are desirable indirectly—because they make a return to the community in general, through better health, greater taxable capacity, higher standard of living and increased consumption demands, and so on. Fourthly, because it prompts the recurrent vicious cycle of trade boom and trade depression.

Already the world has moved far from simple *laisser-faire;* but the present system is a compromise and the agencies of collectivized organization and planning are as yet extremely imperfect.

The fifth point is the gradual evening out of world resources in raw material and power. This has been accomplished partly by new methods (for instance, utilization of nitrogen from the air instead of from the Chilean nitrate beds); partly by artificial substitutes (such as synthetic dyestuffs, artificial silk, plastics); partly by new transformations of old sources of material or power (motor-spirit from coal; hydro-electric power); partly by substituting new raw materials for old (for instance, aluminum for heavy metals). The net result has been that, while many inequalities of distribution remain (U. S. helium; Canadian nickel, etc.), the bulk of natural resources, both in materials and in power, is becoming much more uniformly spread over the habitable globe.

The sixth striking feature of our time is the great increase in leisure—some of it in the compulsory form of unemployment and retirement at comparatively low ages.[2] The totalitarian countries have made some interesting attempts to provide new social organizations for the better utilization and enjoyment of leisure, but so far in other countries the individualistic *laisser-faire* tradition, which tends to regard all state-controlled organization as undesirable interference, has prevented any real evolution in this direction.

Seventh, there is a new attitude to colonial problems. Partly this is due to the jealousy of the have-nots, a normal phenomenon whipped up to exceptional intensity under pressure of nationalist feeling; but in large measure it is due to a new attitude, which has already found expression in the mandatory principle, to a dawning realization of world unity and to the part to be played therein by peoples whose social development has been retarded.

What suggestions of scientific method and of biological analogy can be made for helping mankind to deal with the acute problems arising from these new features of our time?

[2] During actual war, much of this leisure is of course abolished.

We have drawn one evolutionary analogy—that of the over-armed and under-brained reptiles of the late secondary era. We can not, however, suppose that the subsequent course of biological evolution will serve as a pattern for the next phase in our own history. This would imply that the over-armed nation-states would disappear and their places be taken by smaller nations more concerned with flexibility and intelligence of social behavior. This is ruled out by the shrinkage of the world and by the biological peculiarities of man. Do not let us forget that man differs from all other major biological types in consisting of but a single inter-fertile species, in possessing much greater control over the environment, and with the power of forming much larger communities. The only possible climax for such a type is that it should extend over the entire habitable globe in the form of a single community, whatever the organization of that world community may be. All intermediate stages, of racial, tribal, national groups, are inevitably unstable and temporary phases.

But for the immediate future, both biological analogy and historical experience demand a step-by-step advance. Some functions are sufficiently advanced to be put on a world footing without dislocation, while for others the step can only be on to a regional basis. The chief functions which could be stepped up to a world platform are those concerned with primary products and raw materials, with certain aspects of research and of communications, and with sea-power. The chief functions for which we must be content with the intermediate regional step-up are the political, in the broad sense of the word.

Let me amplify this second point first. National culture and tradition, usually combined with language, is the strongest political force in the world to-day. So-called race problems, when analyzed, always turn out to owe their acuteness to differences in culture and economic level which happen to be associated with quite minor genetic differences.

It is wholly premature to envisage any immediate world-government which could stand up to the tensions introduced by existing differences in national culture. Regionally, however, there is a hope.

The U.S.S.R. has already established a federal system over one-sixth of the world's land area. Pan-America is beginning to emerge. The present struggle between Japan and China could without too great difficulty be forgotten in a Far Eastern federation. Malaya and tropical Africa are destined by nature to take their place as world regions as their inhabitants progress toward economic efficiency and political self-government. And finally there remains Europe. I use the word Europe in a cultural sense, as that region where western civilization arose and where it still

flourishes, however impeded by the barriers of nationalism and the counter-currents of totalitarian philosophy; regionally, the geographic Europe minus European Russia but plus the Asiatic and African fringes of the Mediterranean Sea.

The most urgent political post-war task is the settlement of this European region. It is here that the greatest number of powerful nationalisms occur, here that they are most crowded, here that the ownership of tropical territories is chiefly concentrated. Geography and history alike dictate a regional solution for this area, now torn by war. And the war is a civil one, between different representatives of the European tradition—the tradition based on Greece, on the Roman empire, on western Christianity, on representative government, on the spirit of modern science, on technology.

Yet the differences between the various nations or groups of nations within Europe are so great, their separate traditions within the enfeebled European tradition so strong, that it would be hopeless to attempt at one bound a full-fledged federal system like that of Switzerland or the U. S. A. On the other hand, a League system, even if confined to Europe, will not be enough—the experience of the League of the American States prior to their federation reinforces the lesson of the last twenty years. A League system will not work because it is a contradiction in terms: the absolute sovereignty of its member states is irreconcilable with collective action for the benefit of the whole. Some abrogation of sovereignty—in other words, a step towards federation—is essential.

What is the minimum degree of federation which would be effective? An executive organ, an advisory organ, an organ of discussion, a financial organ, a training organ, a judicial organ, an organ of opinion, a budget, well-defined restrictions on freedom of action in political and economic matters and, in the present state of the world, alas, an armed force and machinery for sanctions. The executive organ could be restricted to a council, in which smaller countries could be represented groupwise, or preferably as federated units within the greater and looser federation. The organ of discussion would be some sort of assembly, not necessarily elected by western democratic methods, but representing functions as well as regions. For training there is needed some form of international staff college; for moulding opinion back toward unity and away from nationalist separation, broadcasting services and perhaps a film service, together with a European system of university education and newspapers and periodicals. The financial organ would include a European Bank; the judicial organ would be a European Supreme Court.

While it would almost certainly prove impracticable to have a single monetary currency for all Europe or to make it a single tariff area with full internal free trade, it would be essential that none of its constituent units could alter their tariffs or the valuation of their currency without the permission of the council. The budget might be raised as a percentage levy or in various other ways (*e.g.*, from tariff revenue): the one essential is that it should be adequate in amount—at least half a billion dollars per annum. Inadequacy of finances was one of the reasons for the failure of the League. The extent of the inadequacy may be seen from the fact that the total of the contributions of member states during any of the last few years was just about as much as what the London County Council spent annually on main drainage alone! As for armaments, if the European Council alone disposed of military planes, heavy tanks and heavy artillery (whose manufacture can not be kept secret) then effective disarmament, both qualitative and quantitative, could be imposed on member nations, and yet Europe as a whole would dispose of a powerful force. The units of the force should presumably be stationed, whenever possible, in the territory of small nations: that would be one of their chief contributions to collective security. Sanctions could be operated by withholding supplies of key minerals, under the world control scheme considered later, and also by a ban on exports from the offending unit, as was done by Great Britain in her recent dispute with Eire.

The budget would be mainly employed, apart from armaments, on long-term development schemes which would not readily attract private capital—partly in Europe (and there mainly in the less developed regions, though special projects could be contemplated in any country), partly in the colonial dependencies. But a reasonable fraction would be reserved for the other European agencies and for leisure organizations on a European scale.

To these last I shall return. Meanwhile let us consider world organizations. Some or all of these would presumably be part of a remodelled League of Nations (though there are some who would prefer a wholly new world authority set up to supersede the League).

In the first place it would be desirable to extend the Research and Health Sections of the League very considerably. Next, it is urgent to establish a world organization concerned with population policy—emigration and immigration, refugee problems, the rural-urban population ratio, birth control for over-populated areas, etc.

Most important, however, would be the economic organizations. These would fall under three main heads—those designed to liberate world trade from undue restrictions, those designed to regulate the output of commodities, notably raw materials and primary products, and those designed to increase the prosperity and purchasing power of backward areas. Those of

the first type call for no special comment. Those of the second would have as their basic functions, first to iron out the vicious cycle of slumps and booms, and secondly to promote a higher standard of living through higher consumption. The League has been blamed, perhaps rightly, for its lack of proper organization on the economic side. It is, however, fair to remember that in 1919 the machinery for large-scale control of raw materials was virtually non-existent. Most of it was called into being by the great depression of 1929 and subsequent years. It exists to-day in the form of cartels and other international schemes for commodity control. From the technical aspect of economic machinery, these have been much improved during the last decade: it remains to alter their direction, to harness them in the interests of consumption and of the general public instead of permitting the dominance of a policy of restriction and short-term profits for sectional interests. From the technical point of view, the provision of really adequate buffer pools and the wholehearted application of scientific research would also lead to improvement.

They would be under a Permanent Commodities Commission of the League of Nations or whatever world international organization took its place. In addition, such a body would have the duty of supervising organizations of our third type, aimed at canalizing world long-term investments for development purposes. Such an aim would be achieved partly by means of rural and other loans, international public works, and the like, partly indirectly through the setting up of what might be called International Chartered Companies and Regional Development Commissions, to promote the general development of backward areas. The latter are suitable for self-governing territories, where they cooperate with a local administration. The Depressed Area Commissions in Britain and still more the T.V.A. (in its general, as opposed to its "yardstick" program) provide possible models for such bodies. They should also be employed by the European Council. For non-self-governing territories (colonies) with really backward populations, such a set-up would not work. Here the International Chartered Companies could find their use; such bodies would (as with similar semi-public organizations like the London Passenger Transport Board) operate on a basis of limited profit, making over everything above this for the development of the area for which they were responsible, as well as being under international supervision.

We may take colonies next. Here, as with Europe, the task is to steer a safe course between the Scylla of doing nothing and the Charybdis of attempting too much and seeing the shaky edifice collapse. It is easy enough to say, as many people are saying (and sometimes shouting!) that all colonies should be handed over in the immediate future to an international administration. But would it work? Those who know something about native peoples and the problems of tropical administration say "no." There must be somewhere in the system a firm organ of authority and an adequate focus for the loyalty both of those administered and those who administer them. Until the incipient federation of Europe that we have outlined grows into a true Federal Government, and until training and tradition have produced an *esprit de corps* in the international administrative service, these essential organs of colonial administration will not exist on the international plane. To take a somewhat remote yet valid biological analogy, before the development of the cerebral cortex, lower vertebrates had to delegate most of their behavior to a rather poorly constructed system of reflexes and simple instincts.

The remedy would seem to be retention of the principle of national and executive authority at the periphery, with a reasonable and increasing degree of international non-executive control at the center. The separate colonies and their administration would remain British, French, Belgian, and so on, though they should all be put on the footing of mandates, and the Mandates Commission strengthened by the grant of powers of investigation on the spot in addition to those of mere review of policy. Under the European Council would be established a Colonial Commission, truly international, with small but picked international staff of research workers, experts and traveling advisers, *and* the power of allocating considerable grants out of the European common budget, for education, for health, for conservation, for roads and other public works in the separate colonial territories.

It would be desirable that a small but progressively increasing fraction of the technical and perhaps later of the administrative posts in the local services should be thrown open to nationals of other countries, but the appointments should be in local hands, not in those of the international authority.

A somewhat similar system works quite successfully between the Federal and State authorities in the Tennessee Valley Authority, and it ought to work well enough in the colonial sphere.[3] Do not let us forget that international administration is *per se* no solution of the basic colonial problem, which is the welfare of the native inhabitants and the development of the colonial territories towards self-government. It could only help at the European end, in reducing jealousy among the great powers. But even the partially international scheme set forth above would remove most of the political objections to the transferring of colonial mandates to other powers.

[3] The scheme would have to be modified in the minor colonial areas, such as the Caribbean and the Pacific, to allow of the participation of other powers, *e.g.*, the U. S. A. and some of the British Dominions.

Meanwhile the world organization, too, through its International Chartered Companies, its rural loans, its international public works and its expenditure on research, would be aiding in the progress of the tropical countries. The International Staff College would have its colonial section, and, after perhaps a generation, there would have been built up a truly international *esprit de corps* among the staff, which would then permit the full internationalization of the colonial system.

I previously mentioned the growth of leisure and the need for its better organization. This is especially urgent in Europe, for it will be largely through such organization that the people of its separate countries will be able to understand the European tradition and to participate in it, only so to experience the greater European loyalty which will render the lesser national loyalties innocuous, as inspiring a sense of local but cooperative pride instead of a sense of jealousy and hate. To do this, the democracies must learn from the totalitarian states; they must build up their own leisure organizations, and then extend the principle internationally.

One can think of so many ways in which such organizations could promote "life, liberty and the pursuit of happiness" on the international plane. Cheap travel, properly organized in international parties; youth hostels, walkers' and climbers' hostels, all over Europe; international festivals, like Salzburg in the old days, or Oberammergau, but more numerous and made available to many more people; an international system of holiday camps, of summer schools, of study and hobby groups, of retreats, dotting Europe from end to end. The whole could easily be linked up with the extension of the exchange system which will be necessary on the educational side—exchange of undergraduates, of graduates, of teachers and professors, to a certain degree of schoolboys; and also with international schemes of adult education and of refresher courses for administrators and professional men of every description.

One may even envisage the substitution of international citizen service (preferably voluntary) for national military conscription and the placing of that, too, on a broad inter-European basis.

In all such ways, Europe could become a reality to its inhabitants, and the onward flow of its great cultural tradition would be reenforced.

Let us try to envisage what improvements such changes would bring about. Nationalism and self-determination would not disappear; but they could be relegated to the cultural sphere (as has been largely done in the U.S.S.R.) and banished from that of economics, power politics and war. Political boundaries and national governments would continue to exist; but their importance, and especially their importance in causing trouble, would be reduced. The risk of conflict between major regions would remain until the time was ripe for world as opposed to regional federation. But the financing of development schemes in the poorer or less advanced countries, and the reduction of economic distress by ironing the bottom out of depressions and by planned schemes for world production and distribution of raw materials and primary products would remove some of the chief causes of unrest and war. The deliberate employment of state and international organizations to enrich life for the individual citizen would give a new meaning to the common man's existence, and help in establishing the new mystic, the religion of this world, which is so urgently needed to reinforce the old other-worldly religions and to replace the crude pseudo-religions of state worship.

The proper utilization of the new resources offered to man by science, by which the raw materials that he needs, the sources of power, the productivity of the land and the possibilities of better living can be in large measure spread equally over the globe, will begin to remove the disastrous separation of the world into exploiting and exploited areas, and so pave the way for a true federation of federations.

Friction and difficulty will remain: we have the fundamental biological analogy of hostile symbiosis of the parts within the body to remind us of that. But man and his societies are organisms, albeit with their own unique nature; and the equally fundamental biological analogy between animal and social evolution shows us that the difficulties can be overcome, and the friction of the parts subordinated to, and even utilized for, the benefit of the whole.

But do not let us delude ourselves into thinking that it will be easy. Wishful thinking issuing in impractical schemes is one of man's unique biological attributes. Historical experience demonstrates that the only method for the adequate control of complex phenomena is the scientific method. The biological analogy with evolution demonstrates that the most important line of evolutionary progress has been through the improvement of brain-mechanism, notably the mechanism for acquiring knowledge and correlating it with action.

The corresponding social machinery is yet in its infancy. The end of the war will face the world with a task for which it is ill prepared. It is urgent that every country, and perhaps most of all those countries which are not actually immersed in the struggle, should begin thinking out the plan of the new world order in detail, designing machinery which will work, as well as defining the limits of their own participation. It is equally urgent that the world, perhaps again chiefly through those countries like the U. S. A. which are already best equipped technically for the task and are not being diverted from it by the needs of war,

should begin constructing planning organizations on a large enough scale to function as a social brain and not a mere ganglion, in order to ensure that any first step which we may be able to take directly after the war will be a step in the right direction.

But again, do not let us attempt any ideal or complete plan, any grandiose scheme for which the world is not ripe. That was one of the causes of the League's failure; it was an attempt to impose an ambitious ready-made plan of world citizenship, for which public opinion was insufficiently prepared. Rousseau and the Encyclopedists had been preparing opinion for a radical change in society for half of the eighteenth century; without that preparation, the French Revolution would have been a fiasco. In 1918, the idea of supernational organization had not penetrated beyond a limited circle of intellectuals, and even they had not had time to work out the idea in detail, before Wilson sought to impose it in reality. To-day we have at least had twenty years of discussion, together with some bitter if salutary experiences. If the leaders of thought in the various nations can now work out a less pretentious but more workable plan, and at the same time can prepare public opinion for the idea of a dual citizenship, national and world, this war may be the occasion for taking a small but decisive step away from war and towards a world organization of humanity.

THE GRAVITY ANOMALY AN IMPORTANT FACTOR IN EARTH SCIENCE

By Dr. WILLIAM BOWIE
U. S. COAST AND GEODETIC SURVEY, RETIRED

THE difference between the observed and the theoretical value of gravity, called the gravity anomaly, is receiving much attention by students of the earth who are striving to discover the causes of the changes that have occurred in the configuration of the surface of the earth during the past 2,000,000,000 years. Why are there oceans and continents, mountain systems and broad lowlands, earthquakes and volcanoes? What is the shape of the sea-level surface? How far down do the hard crystalline rocks extend? Is the rock below the outer shell lacking in rigidity and strength? These are some of the problems which were discussed by several hundred delegates to the seventh general assembly of the International Union of Geodesy and Geophysics, held in Washington early in September of last year.

In most countries there are governmental and private agencies and educational institutions in which geodesists and geophysicists are studying the earth with a view to the solutions of the problems enumerated above. These problems are also receiving the attention of many geologists, especially those who are searching for minerals and petroleum.

There are many phases to the sciences of geodesy and geophysics and it would require several large volumes to cover them in a comprehensive way. In this paper I shall confine my comments to one phase only of the earth sciences, the gravity anomaly.

In deriving the formula for theoretical gravity the sea-level surface of the earth is supposed to be a spheroid, with its shorter axis coinciding with the polar axis of the earth. This assumption has been found to be close to the truth. The sea-level surface deviates not more than one or two hundred meters from the spheroid or mathematical surface. The geoid or sea-level surface is above the spheroid for continental areas and below it for oceanic areas. This is as it should be, for the spheroid is an average of the geoid.

The constants of the gravity formula are derived from observed values of gravity in many countries and at different latitudes. Different groups of stations will furnish different sets of constants.

The International Geodetic Association has adopted the following formula which is based on a large number of stations located in many countries: $\gamma_0 = 978.049 (1 + 0.0052884 \sin^2 \phi - 0.0000059 \sin^2 2\phi)$ gals, in which γ_0 is the value of gravity at sea level and ϕ is the latitude of the station.

Further gravity measurements will make it possible to obtain constants that should be of more universal application. But it is believed that with the data now available it may be possible to derive constants for the theoretical formula that will enable the student of earth science to more correctly interpret the significance of the gravity anomaly than he can now do.

In order to derive a gravity anomaly, a number of corrections must be applied to the observed value of gravity, and then the corrected value is compared with the value given by the theoretical formula for the latitude of the station and at sea level. The difference is the anomaly.

Various corrections must be applied. Owing to the irregular surface of the earth, topography and isostasy must be taken into account. Corrections must be applied to the observed values of gravity to eliminate the effect of the topographic masses above sea level and of the deficiency of mass in the ocean basins.

Since it has been proven that the topographic features are compensated by deficiencies of density under land and by excesses of density under the water areas, and that these deficiencies and excesses extend to moderate depths below sea level, corrections for the compensation must be applied to observed values of gravity. An elevation correction must be applied to each station that is above or below sea level. A change in elevation of the point of observation of 10 feet causes a change in gravity of one part in one million. A small correction should be applied for the difference in level between geoid and spheroid. It is not known definitely how far down the compensation extends, nor whether the depth is the same for different parts of the earth. For the United States the depth, if uniform, is about 60 miles. But the effect of the compensation for 50 or 70 miles is not far from what it is for 60 miles. Nor does the compensation effect differ greatly for the irregular depth and for the uniform one.

In making the computations of the effect of the topography and the compensation some density must be assigned to the rocks that appear above sea level. The density most generally employed is 2.67. This value is also used in computing the deficiency in mass of oceans. It is assumed that all rock below sea level has the same density all around the earth for any one layer except as modified by the isostatic compensation. This applies to the rocks under the oceans, though for them the first horizontal layer may have its upper surface one or more miles below sea level.

For our present purposes it may be assumed that the corrections applied to the observed values of gravity are close to the truth for elevation of the station, for the deviation of the geoid from the spheroid and for topography. We may assume also that the errors of observation are not large and that they are of the accidental nature.

Still we find anomalies of relatively large dimensions for individual stations and we find regions of some extent where all or nearly all the anomalies will have the same sign. We find that sea stations have an average anomaly of about plus 30 milligal (30 parts in one million). In the waters of the East Indies and the West Indies and along the east coast of Japan there are narrow strips where all the stations have large negative anomalies. In the United States stations located on recent geological formations have negative anomalies in most cases, and the largest negative anomalies found are in those areas. The largest positive anomalies are at stations located near outcropping pre-Cambrian rock. The anomalies at stations located on volcanic islands are usually positive and in many cases large.

It is generally believed that the large anomalies at land stations are due to the presence near the stations of rock having densities much greater or smaller than that assumed for normal surface rock. Where anomalies of one sign persist over a large area the crustal material may be out of equilibrium or the isostatic compensation may be much closer to or much deeper than is supposed, or the compensation may not be directly below the topographic features.

The persistence of positive anomalies for sea stations may be due to errors in the derived constants of the theoretical formula. If isostasy represents the true condition of the earth, as we think it must, there is difficulty in believing that the positive anomalies of ocean areas indicate a departure from equilibrium of the crust below the oceans. These oceanic areas are not subject to the disturbances due to erosion and sedimentation that occur on land, and there is no indication that the rotation of the earth will distort the globe into a tri-axial form. The anomalies seem to be due to some other cause, and I am inclined to the opinion that it is partly the way in which the constants of the theoretical formula are derived.

There are areas of the earth in which there are few if any disturbing elements. These areas are the portions of the oceans having nearly uniform depths over wide extents and flat parts of the continents on which there are no thick deposits of recent and unconsolidated sedimentary matter. These continental areas are the interior plains, some of considerable elevation.

The densities of the crust under the areas indicated above should be quite regular and normal and for computing the compensation effect the depth of compensation need not be known with great accuracy. Assuming that the topography is compensated, the attractive effect of the topography would be almost exactly equal to that of the compensation, as it is a well-known principle that the attraction of a layer of matter of uniform thickness and of large horizontal dimensions will be the same for different distances of the attracted particle above the center of the layer or if the mass remains the same the layer may have different thicknesses without changing its attractive effect. It is seen that the effects of the topography and the compensation will almost balance in areas that are nearly level and in which recent sedimentary matter is absent. In consequence of these considerations the isostatic gravity anomalies should be free from errors due to assuming an erroneous depth of compensation and should not be seriously affected by errors in the assumed distribution of densities of the crust below sea level.

If we derive the constants of the gravity formula from values secured at stations located on the plains and plateaus of continents and over those portions of the oceans where the depths are fairly uniform for great distances, and if we assume, as seems reason-

able, that for these areas the crust is in equilibrium, would we not be able to use the new formula with effectiveness to show the extent to which the crust under other areas deviates from equilibrium and to arrive at a fair estimation of the real deviation of crustal densities from the normal?

As mentioned earlier, the isostatic anomalies at stations located on thick beds of recent sedimentary rock tend to be negative in sign. This is notably the case in the Indo-Gangetic plain of India, along the coast of Virginia, along the eastern coast of Puget Sound, near the coast of Southern California and in many other places. Similarly, near areas where there are outcropping pre-Cambrian rock, of limited horizontal extent, the anomalies tend to be positive. We wish to be able to evaluate the gravity anomalies in terms of abnormal masses near the stations, and it would seem that this can be done if the constants of the gravity formula are obtained from data secured at stations that are least likely to be affected by local abnormalities of densities of surface and upper crustal matter.

It should be said that in deriving such a gravity formula the observed values of gravity should be referred to the spheroid. This would reduce the ocean values and increase those on land, thus bringing the anomalies into closer agreement. I believe that the stations at sea and on the continents as here recommended for the derivation of a new formula will be found to be in substantial accord. This can not be the case when unselected land stations are used.

During the assembly of the International Union of Geodesy and Geophysics, held recently at Washington, the writer discussed this matter of a new gravity formula with Dr. W. A. Heiskanen, the director of the Isostatic Institute of the International Geodetic Association, and he agreed to derive a new formula along the lines discussed herein. The results of Dr. Heiskanen's efforts will be awaited with interest.

OBITUARY

CHARLES ZELENY

CHARLES ZELENY, professor of zoology at the University of Illinois, died at his home in Urbana on December 21, 1939. He was born at Hutchinson, Minn., on September 17, 1878, and spent his early boyhood days there. Later his parents moved to Minneapolis, and when he was ready for college, he entered the University of Minnesota, where he graduated in 1898. He remained as a graduate student at Minnesota until 1901, at which time he was granted the M.S. degree. The next year he was a graduate student at Columbia University, working with T. H. Morgan and E. B. Wilson, and the following year he worked at the Naples Zoological Station. Returning to America in 1903, he entered Chicago University, where he obtained the Ph.D. in 1904. He went to Indiana University as an instructor in the summer of 1904. Here he advanced rapidly and held the rank of associate professor at the time of his call to the University of Illinois in 1909. Beginning at Illinois as an assistant professor, he was promoted the next year to the rank of associate professor and in 1915 to a professorship. Upon the retirement of Professor H. B. Ward in 1933, he was made head of the Department of Zoology and chairman of the Division of Biological Sciences. Because of ill health, he had retired from his executive duties in 1938.

On May 29, 1911, he married Ida Benedicta Ellingson, of St. Morris, Wis. Mrs. Zeleny and a son, Charles, Jr., survive.

Dr. Zeleny's family is unique in that three of his brothers are scientists of note. Anthony Zeleny, now retired, was professor of physics at the University of Minnesota; John Zeleny is professor of physics at Yale; and Frank Zeleny is an engineer with the Burlington Railway.

As is true with every great man, chronological facts such as those enumerated tell but little of the life of Charles Zeleny. They are cold, external. It was the writer's good fortune to have been a student in Dr. Zeleny's first class in embryology taught at the Biological Station in the summer of 1904. For the next three years, our associations were intimate. We worked together, ate at the same table, played together and tramped through the woods and fields together. The fact that one was teacher, the other student entered but little into our thinking. The friendship formed in those early years remained to the end. As a friend he was true, somewhat reserved, seldom talked of his own personal affairs, possessed a subtle, sometimes mischievous, wit, appreciated by those who knew him best. Seldom did he complain about anything. Bitterness, if present, was kept hidden.

As a teacher he was kind, helpful, encouraging, stimulating. As a zoologist his papers in the fields of regeneration, experimental embryology and genetics speak for themselves. They rank among the best contributions of his time. Originality in thinking stands out prominently in all his work.

In recognition of his attainments, he was elected vice-president of section F of the American Association for the Advancement of Science in 1932, and president of the American Society of Zoologists in 1933.

Dr. Zeleny's death at the early age of 61 years is

not only a loss to his relatives and friends, but to science.

FERNANDUS PAYNE

ALMON ERNEST PARKINS

INCAPACITATED by hemiplegia since the previous September, Dr. A. E. Parkins, professor of geography at George Peabody College for Teachers, passed away at his home in Nashville, Tenn., on January 3, 1940.

Dr. Parkins was born at Marysville, Mich., on January 10, 1879. At the age of 17 he began teaching in the rural schools of Emmett Township, Mich., spending his summers as a wheelsman on the ore boats of the Great Lakes. Obtaining much of his training in the school of experience, he was a veteran teacher of 27 when he received the bachelor of pedagogy degree from the State Normal College at Ypsilanti, Mich., and was even more mature with several years' instruction in high-school and normal-college science to his credit when he finally received his B.S. and Ph.D. degrees from the University of Chicago, the latter in 1914 at the age of 35. During his stay at Chicago he did much writing and research in the field of geography, the materials to be used in the courses and publications of Professors Barrows and Salisbury.

After receiving his doctorate he became instructor in agricultural geology and geography at the University of Missouri, and two years later (1916) joined the staff of George Peabody College for Teachers, where he served for twenty-three years.

In 1905 Professor Parkins married Miss Eleanor Grace Stone, of Port Huron, Mich., who survives him.

Dr. Parkins was an earnest traveler in so far as his teaching duties permitted. He frequently conducted student parties on trips through interesting geographical regions. His more extensive journeys with Mrs. Parkins included visits to the Pacific Coast, Canadian Northwest, Mexico, Newfoundland and Labrador and to Europe.

In his professional activities Dr. Parkins was most vigorous. His presidencies included that of the Tennessee Academy of Science in 1922, the National Council of Geography Teachers in 1925, the Association of American Geographers in 1929. He received the Distinguished Service Award of the National Council of Geography Teachers in 1934, and honorary M.Ed. from Ypsilanti State Teachers College in 1922. For considerable periods he was editor of the *Annals of the Association of American Geographers,* associate editor of the *Journal of Geography,* chairman of the 1933 *Yearbook,* National Society for the Study of Education. He was often consultant, as of the Cotton Division, Agricultural Adjustment Administration, in 1935.

Of his several books the most recent was the monumental "Our Natural Resources and Their Conservation," which he edited with the collaboration of J. Russell Whitaker. The list of his contributions to geographical and educational magazines and the materials he prepared or revised for classroom use would be long indeed.

There are few really great teachers in any age. Dr. Parkins undoubtedly belongs in the list of the great. All of us connected with the college will miss him. His students will feel his absence even more than the rest of us. He was, first and last, a great teacher.

S. C. GARRISON
H. A. WEBB

GEORGE PEABODY COLLEGE FOR TEACHERS

RECENT DEATHS AND MEMORIALS

DR. WILLIAM D. HAGGARD, of Palm Beach, Florida, past president of the American Medical Association and of the American College of Surgeons, at one time professor of surgery and clinical surgery in the department of medicine at Vanderbilt University, died on January 28 at the age of sixty-seven years.

DR. HAROLD MESTRE, dean of Bard College of Columbia University at Annandale-on-Hudson, died on September 9 in his fifty-sixth year. Dr. Mestre was assistant professor of biophysics at Stanford University from 1928 to 1933 and was for one year honorary fellow in the School of Medicine of Yale University. He became professor of biophysics at Bard College in 1937 and was made dean in 1938.

DR. MARION MACKENZIE, who retired as professor of biology at Temple University, Philadelphia, in 1930, died on February 4.

THE Animal Husbandry Building of the Ohio State University, which has been re-named Plumb Hall in memory of the late Professor Charles Sumner Plumb, who until his retirement in 1931 with the title emeritus was for thirty-seven years professor of agricultural chemistry in the College of Agriculture, was dedicated on February 2.

SCIENTIFIC EVENTS

THE NEW YORK ACADEMY OF MEDICINE

THE address on January 4 of the president of the New York Academy of Medicine reviews the activities of the academy during the year 1939. He points out that "in some respects, the academy has made greater contributions during the past year to public welfare, to the welfare of medical education in general, to the welfare of its fellowship, than ever before in its his-

tory." He says, however, that in other ways this has been a disappointing year. He writes in part:

The finances of the academy continue to be a matter of great concern, and because of the necessity for balancing the budget, we have been forced to curtail our activities to such an extent that we can no longer be quite so efficient as in the recent past. This curtailment of activities in every department has been forced upon us because the requested budget for 1940 so far exceeds the academy's income. I regret to say that only a small percentage of the academy fellowship has given the Fund-Raising Committee its enthusiastic support, either through direct financial contributions or by making individual efforts toward increasing academy endowment.

Your Budget Committee has had a good deal of advice as to how the budget may be balanced. It has even been suggested that one activity might be dropped entirely. I can tell you that if all three of the Standing Committees of the academy were abolished, with their paid staffs, the surplus remaining after the budget had been balanced in this manner would be scarcely over five thousand dollars. And then, one day the question might again be raised, as to whether the academy was properly an educational institution, or if it was not rather a private institution maintaining a library and section meetings for the benefit principally of its fellowship.

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So we find ourselves in a serious position, faced with the necessity to curtail the activities of various Standing Committees of the academy and the library, by cutting ruthlessly their requested budgets for 1940, which must entail the loss of competent, well-trained employees of long standing.

I am not in any way exaggerating the dilemma in which we find ourselves. Be assured, we are going to carry on, carry on with all the enthusiasm which the various Standing Committees and their staffs have shown in the past, in spite of these handicaps. We are not planning at the present time to abolish any Standing Committee, and we hope this will never become necessary.

I think I have made it perfectly plain that, if the academy is to go on with its service to the public, we shall have to have more endowment. During the last two or three years a very hard-working Fund-Raising Committee has managed to raise funds sufficient to help carry the burden. It has not been possible, however, to add most of the funds thus raised to endowment; they have in large measure been paid out of current expenses. This is a hand-to-mouth existence which can not be permitted to go on. We shall need additional endowment, if we are to continue to accept our responsibilities as we have in the past, and if we are to continue to develop our capacity for public service in normal fashion.

SYMPOSIUM OF THE SOCIETY FOR DEVELOPMENT AND GROWTH

A SYMPOSIUM on "Development and Growth" was held at North Truro, Mass., in August, 1939. Experts from a variety of fields gathered there for mutual exchange of views and joint discussion of topics of common interest. Representatives of the fields of agriculture, bacteriology, biochemistry, biophysics, botany, cytology, embryology, endocrinology, genetics, histology, mathematics, pathology, philosophy, physiology and zoology concentrated on a single focal issue. Correlation of facts and integration of concepts relating to development were thus promoted.

The success of this concerted effort at synthesis was so tangible that the group, as assembled at the meeting, decided to constitute a permanent body with the aim to rally for joint discussion and closer cooperation all those interested in development and growth, primarily by holding annual symposia of wide scope. Thus, a "Society for (the Study of) Development and Growth" was founded. An organizing committee was elected, which at present consists of Drs. Warren H. Lewis, *chairman;* Paul Weiss, *secretary;* Leigh Hoadley, *treasurer;* N. J. Berrill, Philip R. White, E. W. Sinnott, *members.*

The committee has made arrangements for the next symposium to be held from June 20 to 26 at Salsbury Cove, Maine, with the following program (a half day reserved for each topic):

Thursday morning, "Structure of Protoplasm."
Thursday afternoon, "Synthesis of Protoplasm."
Friday morning, "Colloid Chemistry of Development and Growth."
Friday afternoon, "Chemical Factors of Growth."
Saturday morning, "Physical Factors of Growth."
Monday morning, "Cell Division in Relation to Development."
Monday afternoon, "Size-controlling Factors."
Tuesday morning, "Pathology of Development."
Tuesday afternoon, "Theories of Organization."

On that occasion, further details concerning the organization and scope of the society will be considered. Membership is open to all interested in the synthesis of all studies and knowledge bearing on development in the widest sense. Annual dues have been tentatively fixed at $1; in addition, there will be a registration fee of $1 for those attending the symposium. Those wishing to join the society are asked to communicate with Dr. Paul Weiss, department of zoology, University of Chicago, Chicago.

RESEARCH CONFERENCES ON CHEMISTRY AT GIBSON ISLAND

THE Section on Chemistry of the American Association for the Advancement of Science will again sponsor a series of research conferences this summer to be held at Gibson Island, Maryland, under the direction of Neil E. Gordon, secretary of the section. The schedule thus far arranged is as follows:

Chairman	*Topic*	*Week of*
Dr. C. R. Wagner	"Frontiers in Petroleum Chemistry"	June 17

Dr. E. C. Williams	"Catalysis"	June 24
Dr. H. L. Bender	"Physical Data and Structural Interpretation of Organic High Molecular Weight Type Compounds"	July 8
Dr. C. G. King	"Vitamins"	July 15
Dr. Walter H. Hartung	"Relation of Structure to Physiological Action"	July 22
Dr. Maurice L. Huggins	"Applications of X-Ray and Electron Diffraction"	July 29

All those desiring to receive the complete program, including the names of the speakers and their topics for the various weeks or for any particular week, should apply to the director, Professor Neil E. Gordon, Central College, Fayette, Missouri.

BERMUDA BIOLOGICAL STATION FOR RESEARCH

THE fourteenth annual meeting of the corporation and a meeting of the Board of Trustees of the Bermuda Biological Station for Research, Inc., were held, December 16, in New York City.

Officers elected for 1940 were: *President,* Columbus Iselin, II; *Vice-president,* A. G. Huntsman; *Treasurer,* Ross G. Harrison; *Secretary,* J. H. Welsh.

Reelected as trustees of the class retiring in 1943 were: P. S. Galtsoff, E. N. Harvey, Columbus Iselin, II, Stanley Kemp, H. W. Rand. New trustees elected were: C. P. Curtis, Jr., and G. P. Woollard.

The station has been closed for a few months due largely to the fact that at the outbreak of the war in Europe the director was on leave of absence in England. He has recently returned to Bermuda and since weekly sailings from New York are now being made by an American steamer, the laboratory will be reopened to investigators at once. Those interested in working at the station during 1940 may obtain information regarding accommodations by writing the director, Dr. J. F. G. Wheeler, St. Georges, Bermuda, or the secretary, J. H. Welsh, Biological Laboratories, Harvard University, Cambridge, Mass.

THE PHIPPS AUDITORIUM OF THE COLORADO MUSEUM OF NATURAL HISTORY

THE attendance—463,130 for the year—at the Colorado Museum, Denver, of which Alfred M. Bailey is director, was the largest in its history. During the year the Phipps Auditorium, which seats about 1,000 people, has been erected as a result of a gift of $137,500 by former United States Senator and Mrs. Lawrence C. Phipps, of Denver, and a grant of $112,500 by the Public Works Administration. The program of dedication took place on January 11, with eight hundred invited guests in attendance. Governor Ralph L. Carr, Mayor Benjamin F. Stapleton, Charles H. Hanington, president of the museum, Thomas A. Dines and Senator Lawrence C. Phipps were the principal speakers. Director Alfred M. Bailey showed excerpts from the museum's new color films, and Major Alfred M. Collins, guest speaker, told of his African travels.

The auditorium, which was designed by Architect Roland L. Linder, is 98 feet wide and 140 feet long, of terra cotta, brick and Fort Collins stone. In presenting funds to match the Federal grant, Senator Phipps, long a trustee, expressed the wish that the auditorium "would fulfill cultural needs by making a common meeting place for those interested in the arts and sciences." In designing the auditorium the latest information available on acoustical treatment has been taken into consideration; space is provided for a concert organ and the stage accommodates a seventy-five piece orchestra. The latest type of standard and sixteen millimeter motion picture projection and sound equipment has been installed, including two motiograph standards and one Holmes sixteen millimeter, so that educational programs for adults and children may be provided. The main floor has a seating capacity of seven hundred and fifty, with two hundred and fifty additional seats in the balcony. Motion-picture programs have been arranged for children each Saturday morning and on Sunday afternoons for naturalists, travelers and explorers. Provision has been made for the dismantling of the old North American and South American bird groups and for the installation of new habitat cases. The exhibits will be reassembled in the new cases, with those of the Standley Memorial Wing depicting habitats from the Arctic areas to the Gulf of Mexico, and those in the James Memorial Wing showing bird life from Mexico through South America. The new cases have concave backgrounds with domed ceilings and slanting plate glass fronts seven and a half feet high, and from thirteen to fourteen feet in length. The new type General Electric fluorescent lights have been installed in especially built fixtures. A group of W.P.A. artists, under the supervision of Curator Robert J. Niedrach, are now painting the large panoramic views of the Bering Sea Island Group, the Ice Floe Group, the Alaskan Tundra, the Bonaventure Island Group and several Brazilian backgrounds.

GIFTS FOR SCIENTIFIC RESEARCH AT CORNELL UNIVERSITY

CORNELL UNIVERSITY received gifts amounting to $489,805 during the first half of the academic year ending January 1, the colleges at Ithaca receiving the sum of $349,170 and Cornell University Medical College in New York City $140,635, the total amount representing an increase of $130,651 over gifts of $359,154 received during the same period last year.

Gifts for scientific research, according to the official announcement, included the following:

The Rockefeller Foundation allotted $8,500 to the colleges in Ithaca for research in longevity, Far Eastern studies and reflex behavior research. The Medical College in New York received grants from this foundation amounting to $33,404 for the Rockefeller Chemistry Fund, tuberculosis studies, the operation of the Health Center Division of the Public Health Department, the maintenance of the anatomy farm devoted to animal research and for studies in chemistry.

From the Josiah Macy, Jr., Foundation, grants were received amounting to $13,875 for studies of pneumonia, family health fund, research of neuroses in farm animals, endocrine glands, neurology, senility and for the social survey fund.

Among gifts for the colleges in Ithaca during the half year were $133,949 from the estate of John McMullen. This will be added to the fund established by the university in 1923 for engineering scholarships. It now amounts to $1,945,426 and several hundred students are receiving its benefits.

The National Geographic Society allotted $1,000 for studies of the aurora. Research Associate Albert R. Brand gave $1,100 for research in bird song recording, and the American Philosophical Society made a grant of $600 for research in isotopes. Mrs. Adelaide C. Snyder, of Minneapolis, gave $1,000 for research in the chemistry of nutrition.

The Medical College received grants from the Milbank Memorial Fund amounting to $2,500 for a study of nutrition of adolescents; the Russell Sage Institute of Pathology gave $10,500 for research with the calorimeter and radiometer; the National Infantile Paralysis Fund gave $2,500 for infantile paralysis research; the John and Mary R. Markle Foundation gave $3,000 for pemphigus research; $7,500 was received from William E. Benjamin for research in the department of physiology; the estate of Dr. John Rogers provided $2,573 for a fund for experimental biochemistry; the National Research Council allotted $2,559 for a fund for morphology and metabolism; from the Friedsam Foundation $1,500 was received for a fund for neurology; John Staige Davis, Jr., gave $14,500 for pharmacological research, and William R. Warner gave a fellowship fund of $2,000.

SCIENTIFIC NOTES AND NEWS

THE first award of the Leon Bernard Prize, established by the Health Committee of the League of Nations and consisting of a bronze medal and the sum of 1,000 Swiss francs, was made to Dr. Wilbur A. Sawyer, director of the International Health Division of the Rockefeller Foundation, at a dinner of the League of Nations Association in New York on January 29, as a tribute to his achievements in the field of yellow fever and to his success in extending medico-social protection to the populations of many countries. The presentation was made by former Surgeon General Hugh S. Cumming. Through the death of Professor Bernard in 1934 the Health Committee of the League of Nations lost one of its most prominent members. Being desirous of perpetuating his memory, the committee decided to create a foundation to be known as the Leon Bernard Foundation, the object of which would be the award of an international prize to reward practical achievements in the field of social medicine.

ROYAL W. SORENSEN, professor of electrical engineering and head of the department of electrical engineering at the California Institute of Technology, has been nominated for president of the American Institute of Electrical Engineers. Professor Sorensen has been a consulting engineer for the U. S. Electrical Manufacturing Company in connection with induction motor design. In association with Dr. R. A. Millikan, he developed and patented a vacuum type of circuit breaker. Since 1931 he has served as a member of the Board of Consulting Engineers for the Metropolitan Water District of Southern California, which is building the Colorado River Aqueduct to Southern California.

AT the annual meeting of the Harvey Society, held on January 26, the following officers were elected for the year 1940–1941: *President,* Dr. Herbert S. Gasser, director of the Rockefeller Institute for Medical Research; *Vice-president,* Dr. Homer W. Smith, professor of physiology at the New York University College of Medicine; *Treasurer,* Dr. Kenneth Goodner (re-elected); *Secretary,* Dr. Thomas Francis, Jr. (re-elected); Dr. Nathan Chandler Foot, Dr. Vincent du Vigneaud and Dr. Michael Heidelberger were elected members of the council.

DR. LIBERTY HYDE BAILEY, professor of agriculture emeritus at Cornell University and director of the Bailey Hortorium, was elected president of the American Society of Plant Taxonomists at the recent Columbus meeting.

DR. MAZYCK P. RAVENEL, professor of bacteriology and preventive medicine at the University of Missouri from 1914 until 1936, when he became professor emeritus, has been presented by his former students with his portrait painted by Albert Adams Sloan. The painting has been hung in the library of the School of Medicine. The formal presentation will take place later.

DR. I. M. KOLTHOFF, professor and chief of the Division of Analytical Chemistry of the School of Chemistry of the University of Minnesota, has been elected a member of the Royal Flemish Academy of Science, Literature and Fine Arts.

DR. RUDOLPH M. ANDERSON, chief of the division of biology of the National Museum of Canada at Ottawa, has been elected a corresponding member of the Zoological Society of London.

AT the annual dinner of the Brown University Club of New York City on February 6 one of the three bronze plaques awarded to distinguished alumni was presented to Dr. M. L. Crossley, director of research for the Calco Chemical Division of the American Cyanamid Company.

THE Jefferson interacademy award of a hundred dollars has been given to Dr. F. H. McCutcheon, of the North Carolina State College, Raleigh, in recognition of his paper on "Respiration in the Grasshopper." "Noteworthy papers" are selected by each of the various academies of the southeastern states and submitted to a national committee for the final award.

THE 1939 King award for the most meritorious paper presented at a meeting of the Kentucky Academy of Science has been given to Dr. W. R. Allen, professor of zoology of the University of Kentucky. Dr. Allen's paper was entitled "Science and Human Mores." This annual award of $50 was established for a period of five years by Mr. and Mrs. Fain White King, of Wickliffe, Ky. It is to be presented each year to "the author of the most outstanding paper of the meeting."

DR. JAY B. NASH, chairman of the department of physical education and health of the New York University School of Education, was presented on January 27 at a luncheon of the New York City Health and Physical Education Teachers Association with the Luther Halsey Gulick Award for "distinguished service in physical education and allied fields."

THE Harrison Lectureship Medal of the Pharmaceutical Society of Great Britain was awarded to A. D. Powell on January 9, when he delivered the Harrison Memorial lecture of the society entitled "Drug Standards: their Development and Application." The medal is awarded biennially to commemorate Colonel E. F. Harrison, the distinguished pharmaceutical chemist.

EARL RUSSELL has been appointed William James lecturer on philosophy at Harvard University for the first half of the next academic year, 1940–41. He will give twelve public lectures on "Language and Fact" and will hold a seminar in the department of philosophy. Lord Russell is lecturing this year at the University of California at Los Angeles.

DR. STANHOPE BAYNE-JONES has declined reappointment to the office of dean of the Yale School of Medicine at the end of the five-year term for which he was elected which expires on July 1. He expects to devote more time to his work as director of the board of scientific advisers of the Jane Coffin Childs Memorial Fund for cancer research at the university. Dr. Bayne-Jones had been for nine years professor of bacteriology at the School of Medicine and Dentistry at the University of Rochester before he succeeded Dr. Milton C. Winternitz as dean of the Yale School of Medicine in 1935.

AUGUSTINE W. BLAIR, professor of agricultural chemistry and soil chemist of the department of soils of the New Jersey State College of Agriculture and Experiment Station of Rutgers University, retired on January 2 after serving for twenty-eight years. He is succeeded by Dr. Firman E. Bear, science editor of the *Country Home Magazine*.

DR. HAMILTON H. ANDERSON, assistant clinical professor of pharmacology at the Medical School of the University of California, has resigned to accept a professorship in pharmacology at the Peiping Union Medical College, China.

DR. DON W. GUDAKUNST, who has been associated with the U. S. Public Health Service, has been appointed medical director of the National Foundation for Infantile Paralysis, with headquarters at the offices of the foundation at 120 Broadway, New York City.

A REPORT in *Nature* states that Dr. C. H. Desch, who retired on reaching the age limit from the post of superintendent of the department of metallurgy and metallurgical chemistry of the National Physical Laboratory, England, on December 31, will be succeeded by Dr. C. Sykes, of the Metropolitan-Vickers Research Laboratories. Dr. Sykes will take up his work at Teddington on March 1.

DR. JACOB PAPISH, professor of chemistry at Cornell University, has leave of absence for the second term.

DR. WILLIAM M. MANN, director of the National Zoological Park at Washington, D. C., sailed from New York on February 14. He is leader of an expedition to Liberia sponsored by the Smithsonian Institution. He plans to collect animals and birds for the park.

THE *Journal* of the American Medical Association states that the following medical men are visiting the United States: Dr. Hugo Chiodi with a scholarship of the Rockefellor Foundation to carry on studies in the Fatigue Laboratory of Harvard. Dr. Flaminio Vidal with a scholarship of the Rockefeller Foundation to work on the subject of neurology under Dr. S. W. Ranson in Chicago. Dr. Eduardo de Robertis with a scholarship of the Fundación Devoto of the Academia Nacional de Medicina of Buenos Aires to study histology at the University of Chicago. Drs. Joaquin Llacer and J. Sozzi with the scholarship of the Asociación Argentina para el Progreso de las Ciencias

to study microchemistry in New York University. Dr. Armando Parodi with a scholarship of the Rockefeller Foundation to study viruses at the Rockefeller Institute for Medical Research. Dr. C. Galli Mainini will study nutritional diseases with Dr. E. P. Joslin, of the Harvard Medical School.

DR. HARRISON E. HOWE, editor of *Industrial and Engineering Chemistry*, will deliver a John Howard Appleton Lecture at Brown University on the evening of February 23. His subject will be "Chemistry in the Nation's Business." The lecture is open to the public.

DR. HAROLD C. UREY, professor of chemistry at Columbia University, lectured at the Iowa State College on January 29 and 30. He spoke on "Methods of Separating Isotopes" and on the "Use of Isotopes as Tags in Chemical Reactions."

THE Kappa Chapter of the Society of Sigma Xi, Columbia University, has arranged the following lectures during the spring: February 20, "The Vertebrate Eye and Its Photoreceptors," by Dr. Samuel R. Detwiler, professor of anatomy, Columbia University; March 19, "Genetics and Geometry," by Dr. Edmund W. Sinnott, professor of botany, Barnard College, Columbia University, and May 7, "The Art and Science of the Mayans," by Dr. Herbert J. Spinden, curator of American Indian art and primitive cultures at the Museum of the Brooklyn Institute.

DR. ALAN R. MORITZ, professor of legal medicine at the Harvard Medical School, will deliver the sixteenth Ludvig Hektoen Lecture of the Frank Billings Foundation of the Institute of Medicine of Chicago on the evening of February 23. He will speak on "Medical Science and the Administration of Justice." On the same day there will be a medicolegal conference under the auspices of the committee of the institute on local medicolegal problems, Dr. Oscar T. Schultz, chairman. The morning session, with Dr. Schultz presiding, will be held in the amphitheater of Cook County Morgue and will be given by the scientific staff of the Cook County coroner's office. The afternoon session, with Dean Albert J. Harno, of the College of Law of the University of Illinois, presiding, will be held at the University of Illinois College of Medicine. Addresses will be made by Captain John I. Howe, of the Chicago Police Department; Dr. I. Davidsohn, pathologist of the Mount Sinai Hospital; Fred E. Inbau, director of the Chicago Police Scientific Crime Detection Laboratory, and Benjamin C. Bachrach, public defender of Cook County, and a tour will be made of the Chicago police laboratories.

A CONFERENCE on "Physical-chemical and Organic-chemical Evidence Regarding Crystalline Protein Molecules" was held at the American Museum on February 2 and 3 under the auspices of the Section of Chemistry and Physics of the New York Academy of Sciences. There were one hundred and sixty in attendance. The papers presented, which were in each case followed by full discussion by invited speakers were: "Evidence Regarding the Composition of Protein Molecules," H. B. Vickery, Connecticut Agricultural Experiment Station; "Regarding the Size and Shape of Protein Molecules. Ultracentrifugation, Diffusion, Viscosity, Dielectric Dispersion and Double Refraction of Flow," J. L. Oncley, Harvard Medical School, and "Regarding the Structure of Protein Molecules," B. Warren and I. Fankuchen, Massachusetts Institute of Technology.

THE Southeastern Section of the American Physical Society will hold its sixth annual meeting on March 22 and 23, at the Citadel, in Charleston, S. C. A portion of the program will be devoted to the subject "Applied Physics in the South." Dr. Paul D. Foote, executive vice-president of the Gulf Research and Development Company, has been invited to speak on "Gasoline, from the Point of View of the Physicist."

ACCORDING to the terms of the will of the late Edward Harkness, as reported in the daily press, after specific bequests have been made, one half of the remainder of the estate on the death of Mrs. Mary Stillman Harkness will go to the Commonwealth Fund, the corporation established by Mr. Harkness and his mother for medical research and for charitable purposes, the funds to be used at the discretion of the board of directors; one fourth to the Presbyterian Hospital, of which one unit, the Harkness Pavilion, is named in his honor; the remaining quarter of the estate is left to the following institutions in proportions to be designated by Mrs. Harkness in her will, or to be divided in equal shares, should she fail to do so: The College of Physicians and Surgeons of Columbia University, the Metropolitan Museum of Art, Yale University, Harvard University, New York Public Library, St. Paul's School, Concord, N. H., Hampton Normal and Agricultural Institute, Hampton, Va., New York Association for Improving the Condition of the Poor, Charity Organization Society of the City of New York, and Atlanta University. During his life-time Mr. Harkness gave away a sum estimated to be $100,000,000.

CHARLES AUGUSTUS STRONG, philosopher and psychologist, formerly professor in Columbia University, who had lived in Fiesole, Italy, for the past thirty years, established by his will a trust fund of the approximate value of $133,000, the income of which is to be used for fellowships in science and philosophy. The trustees of the fund are Earl Russell, George Edward Moore and Julian Huxley.

A NEW seismograph station began operation at the Utah State Agricultural College, Logan, on January 26. The equipment of the station consists of a 12-inch acceleragraph of the Montana type which has been installed by the U. S. Coast and Geodetic Survey, and a two-component Wood-Anderson seismograph with a six-second period. Funds for the purchase of the Wood-Anderson instruments were bequeathed to the college by the late Thomas P. Oldham and the station will be known as the Oldham Seismograph Station in his honor. The instruments are installed in the basement of the south wing of the Administration Building. The pier rests on well-cemented gravels deposited as a delta by the Logan River in Pleistocene Lake Bonneville. The approximate geographic location of the station is longitude 111° 49′ west and latitude 41° 45′ north. The station will be conducted by the staff and students of the department of geology.

THE Alaskan Branch of the U. S. Geological Survey has recently started the office compilation of multiple-lens airplane photographs covering an area of about 5,000 square miles in the broad valley of the Tanana River in the interior of Alaska. The area, which was photographed by the Geological Survey in 1938, lies between Fairbanks on the west and the international boundary on the east. The pictures were taken from an elevation of about 15,000 feet, so that one inch on the photographs is equal to about 2,500 feet on the ground. From the photographs there will be constructed a planimetric map that will be published on a scale of 4 miles to the inch. The work, which is under the direction of Gerald FitzGerald, will probably take until the end of the current government fiscal year.

A PRELIMINARY statement recently prepared by the Alaskan Branch of the Geological Survey reports the estimated value of minerals produced in 1939 from Alaska mines as $24,888,000. This brings the total mineral production of the Territory to over $800,000,000. Of the production in 1939, gold accounted for $22,900,000. The value of the platinum metals recovered from its mines in that year is estimated at $936,000, which places Alaska among the half-dozen largest platinum-producing countries of the world.

LIMITED facilities and a limited budget have again restricted the number of students who could be received at the College of Natural Sciences at Yenching University for the present academic year. More than half of the thousand applicants for entrance to the university applied to enter the College of Natural Sciences. The enrolment figures in natural sciences for the fall semester of 1939 show graduate students, 27; seniors, 23; juniors, 54; sophomores, 144, and freshmen, 107. The undergraduate enrolment in the college (excluding freshmen) classified according to departments is as follows: biology, 7; chemistry, 46; home economics, 20; mathematics, 13; physics, 39; pre-medicine, 53; pre-engineering, 12; pre-nursing, 5, and unclassified, 26. The registration for the entire university is 982.

DISCUSSION

THE SMALLER ANIMALS OF THE GREAT PLAINS

THE rodents of the grassland, particularly ground squirrels, prairie dogs, kangaroo rats and jack-rabbits, have long constituted a problem in grazing areas as competitors with live stock. Their increases on the plains are well described by Merriam in the Year Book of the United States Department of Agriculture for 1901. He states that on many parts of the plains prairie dogs were more abundant in 1900 than formerly and their colonies had overspread extensive areas previously unoccupied. This is due to the aid of the settlers, (1) by decreasing the animal's natural enemies, and (2) by increasing the food supply. The settler wages warfare against the coyotes, kit foxes, badgers, ferrets, weasels, hawks, owls, snakes and other predatory animals which had previously held the prairie dogs in check. "The prairie dogs have multiplied until they have become a pernicious enemy to agriculture.

"For example, one South Dakota settler states that about fifteen years ago his children noticed two or three burrows about a mile from his house, and now they have spread over and occupied a full quarter section (160 acres), having surrounded his house and taken possession of all the land near it." Merriam cites many examples of losses, among others, that of a cattle ranch which had its carrying capacity cut from 1,000 cattle to 500 by an increase of prairie dogs, which extended to cover 300 square miles, causing a decrease in population and the abandonment of a post office.

The natural enemies of the plains rodents have been decimated through prejudices and the use of poisons. Also, flesh-eating animals usually have good coats and are trapped for fur. This applies to the black-footed ferret, the present status of which appears to be very much in doubt. Merriam states that this animal alone was capable of holding plains rodents in check. The only report of specimens in recent years comes to the writer from Hamilton County, Kansas, which is near the Colorado line. Merriam also described the method of attack of the kit fox. Of this animal, Seton says, "Harmless as a rabbit, he is harmless to man and man's interests . . . readily takes the poison bait used now-

adays for killing coyotes." The writer has seen only one of these in recent years, and the status is difficult to determine. The badger is somewhat disliked by cowboys because horses may step into its holes with serious results. The prairie dog is nearly equally dangerous, and this rodent increases when the badger is absent. It has been practically extirpated over most of the plains area, in part due to the value of its fur. Similar processes have reduced the hawks and owls of the Great Plains along with all the other flesh-eaters. Many are likely to disappear completely unless some special means is taken to preserve them. When one reads Sweetman's book on "Biological Control of Insects," he wonders why this idea was not extended to control of rodents in grassland areas. A large undisturbed area would afford opportunity for the study of natural biological control of rodent outbreaks and would quite possibly eliminate the constantly recurring exhaustive and dangerous application of poison. For this purpose, an area of natural plains grassland not overgrazed by large animals is essential.

The life histories, water relations and competition of grasses is also in need of extended investigations. The facts of the origin and original habitat of the species occurring as pests under agricultural conditions often throw much light on causes of outbreaks. For example, the pale western cutworm, a pest of cultivated grain, originally lived about the dust wallows of the bison and spread to plowed fields, where similar conditions occurred. This fact was discovered by the Canadian entomologists, who had opportunities to observe natural conditions superior to those afforded in the United States. All these problems require long-time observation on lands where wildlife is managed on a hands-off basis.

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ANAPLASMOSIS AMONG DEER IN THE NATURAL STATE

OVER a period of years, sporadic outbreaks of anaplasmosis have been reported from various cattle ranches in the foothill areas near Mt. Hamilton, California. The source of the infection was never definitely established, but at one ranch, particularly, the suspicion arose on more than one occasion that the disease was transmitted mechanically through the bleeding and vaccination of the herd, although the aseptic precautions with which these procedures were carried out would seem to preclude that possibility.

Since no hunting was allowed on the above-mentioned ranch, the deer roaming the vicinity increased to the point of becoming a nuisance, and permission for their destruction was requested of the State Division of Fish and Game. The request granted, Mr. Gordon True, Jr., of the Fish and Game Division, inquired whether the writers would be interested in investigating the possibility of carriers among these deer and kindly obtained ticks and samples of blood from them at the time the animals were killed. He also reported the deer to be *Odocoileus hemionus columbianus* (Richardson), commonly spoken of as Columbian blacktail or coast deer. Professor W. B. Herms and Dr. D. E. Howell, of the Division of Entomology and Parasitology at the University of California, identified the ticks from the deer as *Dermacentor occidentalis*.

On July 25, 1939, 10 cubic centimeters of pooled blood from five deer were inoculated into a young cow, 217. Three days later, 5 cubic centimeters of pooled blood from two other deer were inoculated into the same cow. Smears prepared from the blood before it was pooled showed a very few typical-looking marginal bodies or Anaplasma in three deer.

Beginning on the seventeenth day following the second injection, the blood of 217 was examined at weekly intervals. The examination on the forty-second day after the second inoculation revealed a few bodies, and from this time on, the blood picture progressed in the manner characteristic of anaplasmosis; that is, the marginal bodies became increasingly plentiful, anisocytosis appeared, followed by regenerative red cell changes; namely, polychromatophilia, punctate basophilia and nucleated red corpuscles. Typical symptoms developed, such as emaciation, quickened pulse and respiration, some drooling from the mouth and slight discharge from the nose. Recovery was fairly rapid.

Neitz and du Toit's report of 1932[1] on the transmission of anaplasmosis to antelopes was supplemented by that of the writers[2] the following year, proving that deer become carriers following inoculation of infective blood and suggesting that, in the natural state, they afforded a potential reservoir of the infection. The experiment here described establishes this possibility as a conclusive fact.

Since *D. occidentalis*, the tick infesting the deer used in this experiment, has already been incriminated[3] as a biological agent responsible for the spread of anaplasmosis, the logical assumption is, therefore, that ticks probably were the sole means of contact between the cattle on the ranch previously mentioned and the deer inhabiting that area.

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[1] P. J. du Toit, Twelfth International Veterinary Congress, III: 325, 1934.

[2] William Hutchins Boynton and Gladys M. Woods, SCIENCE, 78: 559–560, 1933.

[3] William Hutchins Boynton, William B. Herms, D. E. Howell and Gladys M. Woods, *Jour. Amer. Vet. Med. Asn.*, 88, n.s., 41: 500, 1936.

INCREASING THE USEFULNESS OF MAPS

THE practice of making maps divided off into arbitrary regions indicated by A-1, 2, 3, 4; B-1, 2, 3, 4, etc., as a means of locating points, does not meet present needs. Who has not had to scan minutely over such an area on many occasions in search of some town, and after finding it spent additional time in determining its distance from some point of reference by the use of a scale of miles at the bottom of the map? Perhaps the point of reference is on a different map with a different scale of miles, or perhaps other regions on independent maps intervene, in which case the investigation becomes increasingly complex and inaccurate as well. Even if a single map is found which includes the two points in question, distances so measured are only approximate, and they are increasingly inaccurate if one of the points is near the edge of a map representing an area appreciable in comparison with the size of the earth, for the projection of spherical areas on plane surfaces necessarily involves distortion. In any case, knowing that a city is located in C-5 on a particular map gives no information concerning its position on another map or on the earth's surface.

Instead of listing cities and towns in such arbitrary regions, let their latitudes and longitudes be specified; then the simplest space interpolation immediately locates their positions on the map. Determination of approximate distances would be greatly facilitated. Each degree of latitude is almost 70 miles (more nearly 69 miles), and while the linear distance represented by a degree of longitude changes gradually with latitude, those values should be marked on the right and left borders alongside the numbers of the parallels. Not only would we be able to establish quickly approximate distances and directions without even finding the points on the map, but also remembering that each fifteen degrees of longitude represents an hour of difference in sun time, a simple mental calculation instantly establishes the probable difference in standard time between the two regions.

This reform would be advantageous to the tourist and would be an aid to scientific thinking on the part of the layman. Not the least important advantage would be to the grade-school student of geography whose interest would be greatly increased in studying positions of countries and cities with respect to his own position instead of with respect to some locality he has never visited and in which he has little interest. There is, of course, nothing to prevent the scientifically minded student from noting the approximate latitude and longtitude of the places he finds on a globe or map, since lines of latitude and longitude are shown on maps in geographies and encyclopedias in general use, but there is a tendency for one to think he has located a place when he has found it on a map without having made any determination of its absolute position on the earth's surface. Relatively few people are accustomed to making any use of latitude and longitude in the interpretation of maps.

The objection may be raised that it is less simple to list the position of a town as 42° 44′ N, 93° 17′ W than to write it merely as C–5. But obviously the N or S, E or W can be omitted from the individual listings, except for regions near the equator, prime meridian or 180 degrees longitude. Further simplification would be accomplished by recording the nearest tenth of a degree instead of minutes of angle. The illustration above would then appear as 42.7, 93.3 under columns headed, degrees north, degrees west. On the very largest scale maps of small areas, the use of hundredths of degrees might be warranted, but in that case hundreds, tens and possibly units of degrees need not be repeated.

It is true that the general public is not quick to welcome unfamiliar innovations, but most people have learned to interpolate in the use of measuring rods, and an increasingly large number are becoming familiar with the more difficult interpolations in using a slide rule. After a single use few persons would desire the present style of listing of points; but for the convenience of those who still preferred the graphical determination of distance, a scale of miles should be retained to supplement the proposed scheme.

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SPECIAL ARTICLES

MANGANESE DEFICIENCY FOR CITRUS IN CALIFORNIA

MANY investigators of plant physiology have shown that a deficiency of manganese causes abnormal development of plant foliage. Camp and Reuther[1] have described deficiency symptoms on orange and grapefruit trees in Florida soils, while Taylor and Burns[2] have reported them on oranges in New Zealand. Haas[3] has described symptoms on citrus grown in nutrient cultures. Extension and clarification of descriptions of deficiency symptoms on citrus, especially on lemon

[1] A. F. Camp and Walter Reuther, *Florida Agr. Expt. Sta. Ann. Rpt.*, 1937, pp. 32–135.

[2] G. G. Taylor and M. M. Burns, *New Zealand Jour. Sci. and Technol.*, 20(2): 115A–119A, 1938.

[3] A. R. C. Haas, *Hilgardia*, 7(4): 181–206, 1932.

trees, has resulted from recent studies by Chapman, Liebig and Parker.[4]

For many years investigators[5] in California have applied manganese to soil and to leaves of citrus trees in an effort to diagnose the cause of subnormal tree behavior. Results of concluded trials are not definite. Recently, however, responses to manganese treatments have been obtained on citrus trees in the Santa Clara River valley in southern California. Certain vigorous lemon trees in that area normally produce young leaves which are pale green in color with sharply defined green midrib and veins. Very pale green blotches, about 3mm in diameter, appear at random in interveinal spaces. Occasional terminal leaves are devoid of green color. Old leaves are frequently affected with a faint mottling. Spraying of the leaves of one limb of one of these trees with a concentrated solution of $MnSO_4$ in August, 1937, resulted in severe injury and repression of new growth. Some new growth appeared on this limb during 1939, however, and in August was considered normal. No improvement was noticed elsewhere. Liberal applications of $MnSO_4$ in 1937 to the soil about other trees in this area have not yet caused improvement.

In July, 1939, we inspected a lemon orchard in the same valley, in which the trees are subject to premature "decline." Recent foliage of trees in the beginning stages of decline showed typical symptoms of manganese deficiency, as recently determined.[4] Analysis of such leaves indicated a low manganese content. Treatment of several trees on August 2, 1939, by injection with C.P. $MnCl_2 \cdot 4\,H_2O$ solutions and crystals (3–8 gm per 3-inch limb), as well as by spraying with 1.25–1.5 per cent. solutions of this material, resulted in greening of leaves within 15 days. The sprays caused slight burning of tender leaves.

Subsequently, several hundred trees were treated by spraying and injection with corresponding effects. The results indicate a deficiency of manganese for citrus trees in this area. The relations of this condition to premature decline of fruit trees may be of importance.

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THE PRODUCTION AND UTILIZATION OF ALCOHOL BY PLANT TISSUES

SOME recent work in this laboratory on the metabolism of legume nodules and of legume and non-legume roots has led to results which apply to the general problem of the role of ethyl alcohol in plant respiration. Since these results have a broader application than merely to nodule metabolism, in connection with which they will be published in full, it seems worth while to give a brief résumé of them here.

The investigations were carried out partly by the Warburg manometric technique and partly by chemical analysis. The following results were secured concerning the production and disappearance of alcohol in the tissues: (1) Under anaerobic conditions alcohol and carbon dioxide were produced by both nodules and roots in proportions which indicate that alcohol was the chief unoxidized product. (2) Under aerobic conditions increasing amounts of alcohol in the medium reduced the respiratory quotient (R.Q.) of both tissues from about 1.00 (lower for roots) without alcohol almost to 0.67 (the theoretical R.Q. for complete oxidation of alcohol) with only a slight increase in oxygen consumption; and, as shown by chemical analyses, part of the alcohol disappeared. Added glucose increased oxygen consumption slightly. Under complete aerobiosis it did not affect the R.Q. if the latter was already approximately 1.00 but increased it under oxygen deficit or if it was already below 1.00. The effect of each substance occurred in the presence as well as in the absence of the other. (3) In nodules, either without added carbon source or with glucose, increasing the oxygen concentration led to increased carbohydrate breakdown, as shown by the CO_2 evolved and O_2 consumed; while in roots, without added carbon source or with alcohol, and in nodules with alcohol increasing the oxygen concentration led to decreased carbohydrate breakdown.

The following seems to be the most reasonable interpretation of these facts: In the absence of oxygen sugar is fermented to alcohol (chiefly) and carbon dioxide, and in the presence of oxygen both sugar and alcohol (if present) are oxidized competitively to carbon dioxide and water. Any oxidative resynthesis of the alcohol to fermentable compounds as the cause of its disappearance seems to be ruled out because of the apparent lack of any decrease in carbohydrate breakdown in tissues respiring carbohydrate chiefly, and because the R.Q. following the addition of increasing amounts of alcohol to the medium did not fall below that (6.67) characteristic of the complete oxidation of alcohol. (The R.Q. of an oxidative resynthesis is smaller than this.) In these tissues the presence of a sparing action of oxygen on carbohydrate consumed seems therefore to depend on the presence of enough alcohol (or similar fermentation product) to serve as a substitute for a considerable fraction of the carbohydrate.

[4] H. D. Chapman, Geo. F. Liebig and E. R. Parker, *California Citrograph*, 24: 454; 25: 11–15.

[5] L. D. Batchelor, E. R. Parker, G. Surr and R. W. Southwick, unpublished data.

Several investigators[1,2,3,4] have furnished evidence that alcohol can be oxidized by higher plants. However, the previously expressed opinion,[5] based on analogy with animal tissues, that alcohol is less quickly oxidized than sugar and the finding by Kostytschew[3] that it is not always oxidized seem to have dominated much of the later thought on the subject.[6,7,8,9] Partly as a result of this impression, the idea that alcohol is an intermediate in normal plant respiration has been largely abandoned. While the results discussed here clearly do not prove the hypothesis, they do seem to remove one weighty objection to it.

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THE EFFECTS OF A BEEF LIVER FRACTION UPON FAT SYNTHESIS IN RATS

WE have previously shown[1,2] that thiamin causes a synthesis of fat in rats and in pigeons. If a diet low in choline is used to study this effect of thiamin the amount of fat in the liver is increased markedly. Choline, subsequently supplied, exercises its well-known lipotropic action. In the course of an investigation of the effects of other members of the vitamin B complex upon fat metabolism we have employed a fraction of beef liver which contains several B vitamins, including pantothenic acid and factor W. Rats fed a fat-free diet devoid of the B vitamins for a period of three weeks lose considerable weight, and the amount of the fat in the body is greatly reduced. If the animals are then given small amounts of the liver fraction the body fat is increased, for example, from 3 to 7 per cent. and the liver fat from 3 to 17 per cent. The administration of choline, even in large dosage, will not cause the liver fat to be normal in amount, but this effect is secured in a few days by feeding a pancreatic extract, "lipocaic" (kindly supplied by Eli Lilly and Company). A reduction in liver fat may also be produced by feeding a concentrate from rice polish or by giving yeast; neither of these supplements is as effective as "lipocaic" when equal weights are used.

The liver fraction is prepared in the course of the manufacture of an anti-anemic extract from beef liver. The fraction effective in causing fat synthesis is secured by removing the alcohol from the 92 per cent. alcohol solution from which the anti-anemic fraction had been precipitated previously. Information is not available to indicate which constituent of the liver fraction is responsible for the increase in fat synthesis.

The effect of this liver fraction is not a toxic one, as might be produced by chloroform or carbon tetrachloride, since there is a coincident increase in body fat and a rapid gain in weight of the rats. Young animals double their weight in seven days and are active and healthy. We regard these observations as confirmation of the conclusions of Blatherwick and associates[3] that liver contains a water-soluble, alcohol-soluble substance which causes fatty livers when fed to rats. However, in their experiments there was no demonstration of fat synthesis such as we have secured.

Preliminary results show that the liver fraction causes a definite increase in cholesterol. The basal diet and the liver fraction are both free of cholesterol, and it seems likely that the increase in cholesterol may have been due to synthesis. "Lipocaic" not only reduces the total amount of fat in the liver but also diminishes the cholesterol. It is suggested that choline may be concerned with the reduction of neutral fat in the liver, while "lipocaic" possibly exerts its effect upon cholesterol esters. If this assumption is correct, "lipocaic" would not be expected to affect the fatty liver produced by thiamin other than would be anticipated from its choline content, as has been found by Best and Ridout.[4]

These results demonstrate that beef liver contains a substance which will markedly stimulate fat synthesis when fed to rats. The total amount of cholesterol in the liver is also increased in amount. The fatty liver thus produced is highly resistant to the lipotropic action of choline but readily responds to "lipocaic." A rapid means of assaying the potency of preparations of "lipocaic" is thus available.

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[1] M. F. Bugajewski, *Biochem. Ztschr.*, 238: 60, 1931.
[2] P. Mazé and A. Perrier, *Ann. Inst. Pasteur*, 8: 721, 1904.
[3] S. Kostytschew, *Jour. Soc. Bot. Russie*, 1: 182, 1915.
[4] W. Zaleski, *Chem. Ztschr.*, 69: 289, 1915.
[5] T. Takahashi, *Bull. Coll. Agr. Tokyo Imp. Univ.*, 5: 241, 1903.
[6] E. C. Barton Wright, "General Plant Physiology," p. 383. London: Williams and Norgate, Ltd., 1937.
[7] S. Kostytschew, "Plant Respiration" (American edition, translated and edited by C. J. Lyon), p. 92. Philadelphia: P. Blakiston's Son and Co., Inc., 1927.
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[9] Meirion Thomas, "Plant Physiology," p. 281. Philadelphia: P. Blakiston's Son and Co., 1935.
[1] E. W. McHenry and Gertrude Gavin, *Jour. Biol. Chem.*, 125: 653, 1938.
[2] E. W. McHenry and Gertrude Gavin, *ibid.*, 128: 45, 1939.
[3] N. R. Blatherwick, E. M. Medlar, Phoebe J. Bradshaw, Anna L. Post and Susan D. Sawyer, *ibid.*, 103: 93, 1933.
[4] C. H. Best and Jessie H. Ridout, *Am. Jour. Physiol.*, 122: 67, 1938.

THE PIGMENT OF THE VERTEBRATE LENS

A FEW years ago the late H. D. Judd and the writer described the yellow lenses of squirrels, snakes and lampreys.[1] The yellow coloration constitutes one of several types of intra-ocular filters which are widespread among diurnal vertebrates and have a quadruple effect in promoting visual acuity.

At that time it was suggested that yellow lenses might be found in certain other animals, among them the tree-shrews (*Tupaia*), the strongly diurnal geckoes, *Phelsuma* and *Lygodactylus*, and the hyrax, *Procavia*. Some of these predictions have since been fulfilled by investigators whose cooperation is deeply appreciated:

Dr. Hugh M. Smith, of Bangkok, Thai, compared the lens of an adult *Tupaia belangeri* with the "Noviol O" glass which matches the lens of the average sciurid species, and judged it to be "about halfway between Noviol O and colorless."

Mr. Arthur Loveridge, of the Harvard Museum of Comparative Zoology, examined the lens of an adult *Lygodactylus picturatus* on Manda Island, Uganda, and reported to the writer that it was pale yellow.

Procavia seems to be nocturnal rather than diurnal as we had been led to believe; but, on the other hand, the American beaver appears to be fundamentally diurnal or indifferent to night and day, not strictly nocturnal as usually described, and might be expected to have a yellow lens. Accounts of old travelers and recent statements by those familiar with the animal in wild regions indicate that the beaver has readily become nocturnal wherever it is in even light contact with civilization, but is diurnal when quite undisturbed. Protected beavers in such sanctuaries as the national parks have slowly reverted to diurnality in recent years.

A large (50 lb.) *Castor canadensis* obtained by courtesy of the Michigan Department of Conservation proved, however, to have colorless lenses. The beaver retina has not yet been studied histologically, but the small amount of rhodopsin present after thorough dark-adaptation indicates that it contains rods, though these are probably small or small in numbers. The species thus has a twenty-four-hour eye and, having avoided such restrictive specializations as a yellow lens, is able to become nocturnal when it must.

The vertebrate lens pigment—possibly a closely knit group of compounds rather than a single one—has been named "lentiflavin"[1] and was found to be readily extractible only with alkali. Since most melanins (though apparently not ocular melanins) are alkali-insoluble this ambiguous behavior stalemated our attempts at chemical identification and led us to hope for a further clue from the study of albinos.

Some time ago Dr. S. A. Houchen, of Olney, Illinois, kindly examined for us the lenses of a two-year-old member of the famous Olney population of albino gray squirrels (*Sciurus carolinensis leucotis*). He pronounced them "a trifle lighter" than Noviol O. This describes the normal gray squirrel lens; but since the writer could not supply Dr. Houchen with a glass sample exactly matching the latter, it was not certain whether the albino might not show some reduction in pigmentation.

This uncertainty was recently removed when the writer obtained an albino woodchuck, *Marmota monax*. The specimen had one patch of light color on the head and some in the tail, but otherwise (and as regards the eyes) was a perfect albino. The lens proved to be exactly matched by Noviol O, as is that of the normal woodchuck.

The yellow coloration of vertebrate lenses is thus certainly not due to sparse melanin, as in normal human adult and early cataractous lenses. It does not seem to be known whether "melanoid" pigments (which are alkali-soluble) can be formed by albinos. Lentiflavin does not appear to be a carotenoid, an anthocyanin or a flavone, and perhaps represents a hitherto unknown group of animal pigments. Further attack upon the problem of its chemical nature can best be made by investigators living where ground-squirrels (*Citellus* spp.) abound, since in their lenses the pigmentation is rich enough to yield an adequate KOH extract with a minimum of collecting effort.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR THE STUDY OF EXPERIMENTAL AIR-BORNE DISEASE[1]

AN apparatus for the study of experimental air-borne disease, developed in the Laboratories for the Study of Air-borne Infection, consists essentially of three parts: (1) a tight chamber in which to subject animals to a controlled infected atmosphere, (2) a special atomizer which delivers a fine stream of droplet

[1] G. L. Walls and H. D. Judd, *Brit. Jour. Ophthalmol.*, 17: 641–75 and 705–25, 1933.

[1] This study is supported by a grant from the Commonwealth Fund to the University of Pennsylvania for investigations on air-borne infection, with laboratories in the Department of Bacteriology, the Children's Hospital of Philadelphia and the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis.

nuclei derived from cultures of test organisms, and (3) an incinerator providing the influent draft as well as incinerating the effluent air from the animal chamber.

The apparatus, except at the entrance of the influent duct, where the atomized culture is drawn into the influent air stream, works under negative pressure. Flow of air and nuclei through the chamber is uniform. Dosage is regulated by varying the concentration of the fluid from which the nuclei are derived and by varying the time of exposure of the animals within the chamber. Treatment of the air entering the chamber, such as passage through long ducts or treatment with ultra-violet light, is permitted.

Quantitative features of utmost importance in studies of experimental pathology have been proven for the apparatus under severe experience. Dosage is uniform and determinate. Samples taken with the air centrifuge exhausted into the incinerating chimney have independently determined the constancy of the predetermined air infection.

Penetration of droplet nuclei to all the lobes establishes this quantitative method of lung inoculation. Studies showing the importance of dosage in determining the characteristics of pathologic or epidemiologic patterns with virus as well as with acute and chronic bacterial infections will be reported later with collaborators in the special fields.

Quantitative relationship between dosage and mouse mortality observed with air-borne B streptococci is conspicuously absent with air-borne pneumococcus. Compound infection of mice with pneumococcus and streptococcus exceeds the sum of infections with either. Promising experiments on influenza virus are now being conducted. Development of discrete tubercles in rabbits experimentally infected with air-borne tuberculosis has provided a most convincing demonstration of the quantitative application of the apparatus to experimental pathology.

DESCRIPTIVE

Approximate dimensions can be scaled from the drawing (Fig. 1). The infector nozzle is designed to give a flow of one sixth of a cubic foot of air under 20 pounds pressure. This evaporates approximately 1 cc of fluid in 10 minutes. Evaporation of only the very smallest droplets saturates this small air flow. The remainder are thrown out by the rapid whirling of the air and return to the pool of culture fluid. The resulting nuclei are finer than those with which we have had previous experience. The infector works well with quantities above 25 cc and will operate for several hours if the initial charge is as high as 50 cc.

The animal chamber (19 inches in diameter) seats in a seal of disinfecting solution. It is flexibly con-

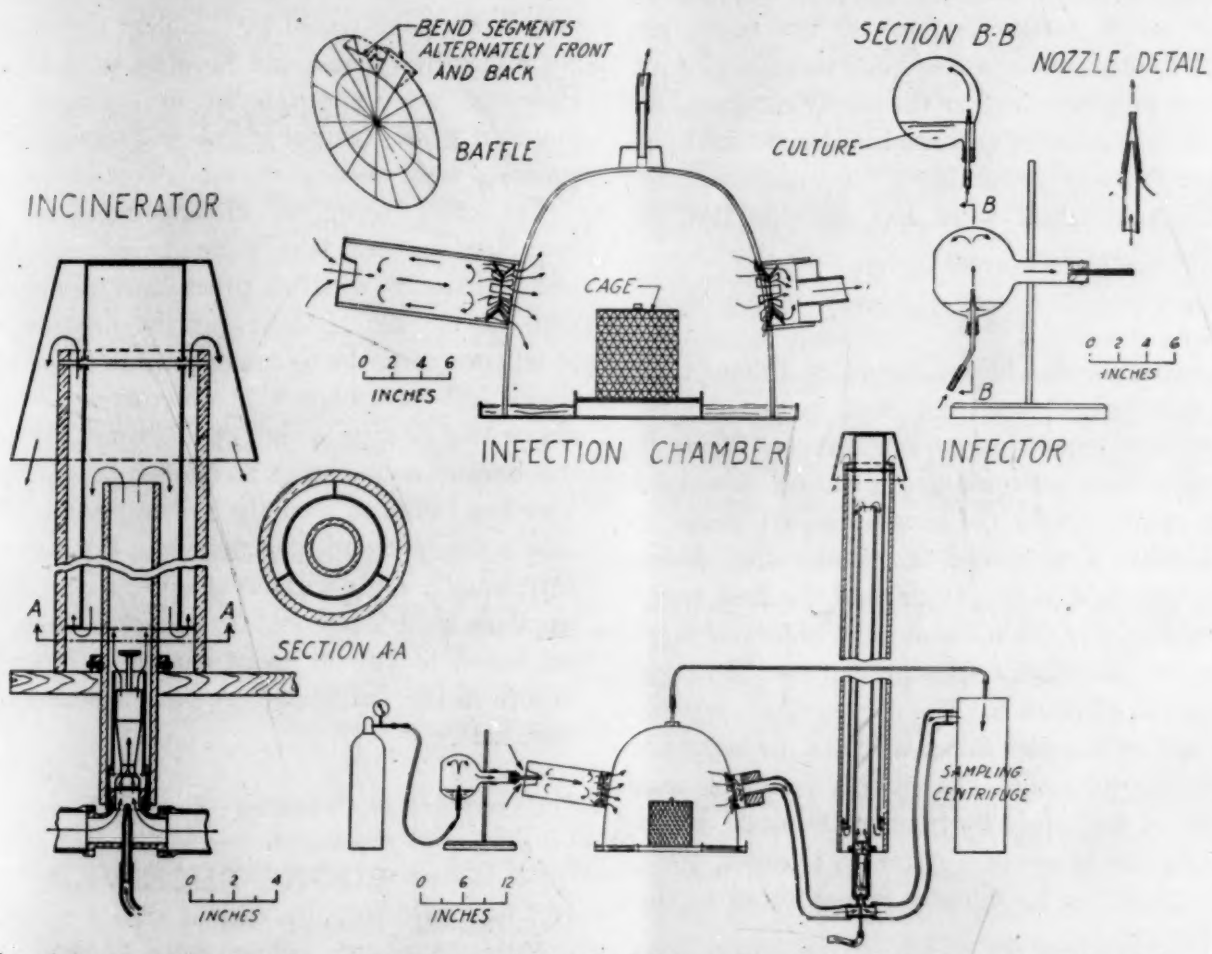

FIG. 1. An apparatus for the study of experimental air-borne disease. Center, exposure chamber; center left, infection flask; center right, incinerating chimney, which also provides flow through the device.

nected to the chimney, and can be lifted when the infector flask is removed from the orifice entrance. Simple baffles distribute the air evenly through the bell jar.

The incinerating chimney provides a flow of 3 cubic feet per minute of air through the system. The top of a Fisher burner, supplied by a special gas jet, supports vigorous combustion within the central 2-inch asbestos tube of the chimney. A central mushroom above the burner produces high turbulence in the combustion section of the chimney. The hot gases rise into an inverted galvanized tube, reversing the flow before entering the outer asbestos chimney. A simple air seal to prevent breakage of the draft is provided by inverting a pail over the top of the chimney. The air centrifuge is also exhausted into the incinerating chimney to avoid contamination of the room air. Ultra-violet lights irradiate the space around the apparatus so as to insure further the safety of operators. The greatest care must be exercised in design and operation to prevent any possibility of a back draft, but a year of experimental work has demonstrated the safety of the apparatus.

OPERATION

A routine run would be conducted as follows: The burner is removed, lighted and reset in the chimney. Animal cages are placed on the platform by lifting the bell jar. The flask containing the culture is weighed and set in position with the nozzle venturi above the pool of liquid. Compressed air under five pounds pressure is admitted to the nozzle, and the flask turned until the culture flows into the stopper well and begins to atomize into the flask. The pressure on the nozzle is now raised to 20 pounds. The degree of air infection is determined by samples taken with the air centrifuge at appropriate intervals. To close a run, the nozzle is lifted out of the liquid by turning the flask, without cutting down the pressure. After 15 minutes, the air is cut off. Another 15 minutes is permitted to flush out the bell jar.

The precautions used in handling animals depends entirely upon the nature of the infection and the animals. They may be dipped in disinfectant; they may be jacketed. Sometimes no precautions are deemed necessary beyond handling the animals with gloves.

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HALOWAX-PARAFFINE FOR INFILTRATING HISTOLOGIC TISSUES

HALOWAX No. 2020 is a hard, tough synthetic patented wax manufactured at the Wyandotte, Michigan, plant of the Halowax Division of the Bakelite Corporation. In reply to my request the manufacturer kindly furnished me the following information: Color, light yellow; flow point, 99–104° C.; viscosity, 34–38 at 150° C. (Saybolt); acid no., less than 0.1; penetration, 15–17; recommended using temperature, 130° C.; price 35¢ per pound F. O. B. Wyandotte, Michigan.

This wax is superior to bayberry wax for hardening paraffine, for the mixture supports the tissue as well as paraffine containing bayberry wax and the sections stick together better, thus forming a much stronger ribbon. My students and I find that difficult tissues, such as thyroid gland and adnexa, small intestine, rabbit appendix and kidney section readily at 4–6 micra after being infiltrated and imbedded in paraffine containing 12 to 15 per cent. Halowax. Refined household paraffine served as well as imbedding paraffine of 50–52° m. p. for this purpose. The tissues were infiltrated in tumblers under desk lights. No difficulties that could be attributed to the use of Halowax were encountered in ordinary microtechnique in which several stains and various methods of staining were used.

The chief technical disadvantages of Halowax-paraffine concerns the difficulty of getting the two waxes to mix without precipitation during cooling and the marked tendency of the mixture to lose its toughness after being used several times so that the tissue fails to ribbon. If the waxes are heated well above the flowing point of Halowax, removed from the burner and stirred frequently until the temperature has fallen to near the melting point, then poured into a tumbler and placed in cold tap water, the mixture usually cools without precipitation. Since xylene appears to be detrimental to this mixture, tissues are subjected to two or more changes of good paraffine before being infiltrated and imbedded in Halowax-paraffine.

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